EFFECT OF VESTIBULAR STIMULATION ON VOLUME VELOCITY OF THE CEREBRAL BLOOD FLOW AND SYSTEMIC ARTERIAL PRESSURE

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UDC 612.14 + 612.824]-06:612.886

Changes in the blood flow in the vessels supplying the brain and also in the extracranial vessels of the head were studied in anesthetized animals in response to electrical stimulation of the vestibular apparatus. A more marked increase in the blood flow in the internal than in the external carotid artery was found in dogs. In cats the changes in the blood flow in the maxillary artery were inconstant. In most experiments the systemic arterial pressure was lowered. The changes observed in the blood flow indicate an active response of these vascular regions to vestibular stimulation, for they are also observed in experiments in which the regional arterial pressure is stabilized.

As well as maintaining the equilibrium of the body and spatial orientation, the vestibular apparatus also influences the arterial pressure and cardiac activity [8, 10, 11]. Klosovskii [4] and other investigators [6, 7] have observed differences in the character of the response of the brain vessels to vestibular stimulation.

It was accordingly decided to study the effect of vestibular stimulation on the volume velocity of the cerebral blood flow with the arterial pressure in the major arteries of the brain stabilized and unstabilized, and also to investigate responses of the cerebral vessels and extracranial vessels of the head to vestibular stimulation.

EXPERIMENTAL METHOD AND RESULTS

Acute experiments were performed on 20 adult dogs anesthetized with chloralose and urethane and 12 dogs anesthetized with morphine and hexobarbital, under controlled respiration [1]. The bulla was opened, revealing the fenestra rotunda on its medial wall. The vestibular apparatus was stimulated by a series of square pulses (10/sec, 3-10 V, 10 msec), for periods ranging from 10 sec to 1 min. Altogether three or four periods of stimulation were used in the experiment.

The volume velocity of the blood flow was determined with a flowmeter [2] and the regional arterial pressure was stabilized by the apparatus described previously [3]. The apparatus was connected to the cats' carotid arteries, the extracranial branches of which were ligated with the exception of the maxillary arteries [5, 9].

In dogs the blood flow was measured in the internal carotid arteries. In some experiments a parallel investigation was made of the blood flow in the internal and external carotid arteries, all connections between the intracranial and extracranial vascular systems of the head having been severed. The arterial pressure was recorded in the common carotid artery by a mercury manometer.

Department of Otorhinolaryngology and Department of Pharmacology, Semipalatinsk Medical Institute. (Presented by Academician V. V. Parin.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 72, No. 11, pp. 3-4, November, 1971. Original article submitted July 7, 1970.

In response to vestibular stimulation the blood flow in the maxillary arteries showed various changes when the arterial pressure was not stabilized (16 observations on cats). In six cases the blood flow was increased by 5-38%, in seven it was reduced by 8-20%, and in the other three experiments no appreciable change was found. In the series of experiments as a whole the blood flow was not significantly changed. In most cases the results of vestibular stimulation appeared after 1 min and were no longer visible after 5-6 min, but sometimes they could be recorded for up to 15 min or more. The systemic arterial pressure was slightly reduced (by 6 ± 1.5%) during stimulation by a current of 1-3 V. In response to stronger stimulation (5-10 V) the pressure was reduced by 20-30%.

In the experiments of series II (nine observations) the blood flow in the maxillary artery was measured when the arterial pressure was stabilized. In three cases it was increased by 14-25%, in two it was reduced by 5-8%, and in three it remained unchanged.

The experiments of series III were carried out on dogs in which the cerebral blood flow was measured in the territory of the internal carotid artery when the arterial pressure was stabilized. A parallel investigation was made of the blood flow in the extracranial vessels of the head. In every case a definite increase in the volume velocity of the blood flow was observed in the internal carotid artery (on the average by 44 ± 5.1%) and in the extracranial vessels of the head (by 27 ± 8.1%). The effect began 10-15 sec after the beginning of stimulation and lasted for 3-7 min. The systemic arterial pressure fell by 20-30% and then rose to its original level. The changes in the blood flow thus were largely due to an active response of the vascular territories investigated, for they were also observed in experiments in which the pressure in the major arteries of the brain was stabilized.

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